CHEMICALS
Project Fact Sheet

Production and Separation of Fermentation-Derived Acetic Acid

Benefits

- Potential reduction in natural gas use of 18 trillion Btu by 2020
- Reduced transportation costs
- Allows for economic acetic acid manufacture in small-sized plants

Applications

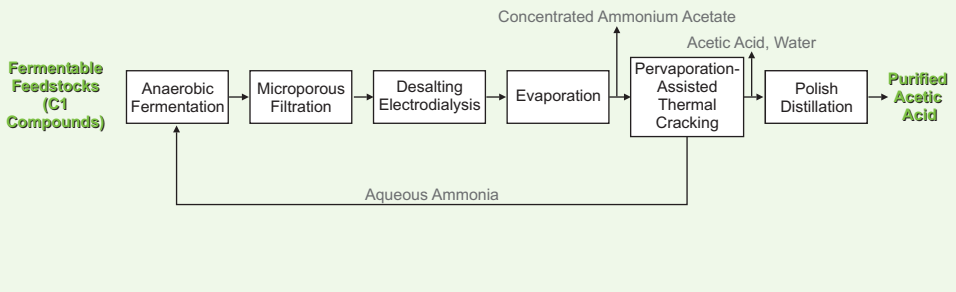
Acetic acid is an important chemical for the manufacture of plastics. Nearly half of the acetic acid produced is used in the production acetate monomer and a third is used for acetic anhydride. Acetic acid is also used as a process solvent in terephthalic acid manufacture, which is in turn used to produce polyester.

The Production of Acetic Acid in Scalable-Sized Plants has Potential Economic and Energy Benefits for the Chemicals Industry

Acetic acid is a large volume chemical product. The United States is the world's largest producer of virgin acetic acid, with 2.3 billion pounds in 2000. Nearly half of the acetic acid produced is used in the manufacture of vinyl acetate monomer (VAM) and a third is used for production of acetic anhydride. Currently, 80 percent of the U.S. production of virgin acetic acid is produced by methanol carbonylation. However, this synthetic process requires relatively high temperatures and pressures, a toxic/corrosive environment, exotic materials of construction, extensive safety-related equipment. The result is high capital cost and low scaling factor, which makes only very large plants economically feasible (500- 1000 million pounds per year). At these plant sizes, significant distribution networks are required, and transportation costs become a large factor in the contract selling prices. Therefore, there are strong market, economic, and energy benefits to developing processes for production of acetic acid in scalable, regional-sized plants, such as fermentation.

The advantages of producing acetic acid by fermentation include its appropriateness for small-scale production, lower cost feedstocks, low energy membrane-based purification, and lower temperature and pressure requirements. Potential energy savings of using fermentation are estimated at ~18 trillion Btu by 2020 from a reduction in natural gas use. Decreased transportation costs with regional plants will eliminate approximately 200 million gallons of diesel use, for combined savings of 45 trillion Btu. If the fermentation process captures new acetic acid production, savings could include an additional 5 trillion Btu from production and 7 trillion Btu from transportation energy.

Fermentation-Derived Acetic Acid Process



Schematic process for production and purification of fermentation-derived acetic acid.

Project Description

Goal: The goal of the project is to commercialize fermentation-derived acetic acid by 2010, which will allow for economical, regional-sized processing plants.

Recently developed pervaporation membranes can have high ammonia permeation. This can enable pervaporation-assisted thermal cracking of ammonia acetate, recovery of ammonia and water for recycle, and acetic acid for further purification. This technology opens a pathway for commercialization of regional smaller-scale acetic acid and other volatile organic-acid production plants, which are of great interest to the chemical industry

One of the existing barriers with anaerobic fermentation is that anaerobic acetogens are most productive at near neutral pH. This sensitivity to low pH is overcome by exporting the acid, a thermodynamically unfavorable process. The project team will attempt to develop an integrated fermentation-derived production and purification process that addresses the barriers of acidification, cation recycling, and economic recovery of the acid. Another critical technical barrier that must be addressed is microorganism survival under conditions that facilitate separations. Using genetic sequence analysis and strain development, the project team will select and adapt acetogenic bacteria for salt tolerance in order to maximize production levels. The approach facilitates separations and avoids the thermodynamically unfavorable and economically unachievable target of high concentrations of free acid production by anaerobic microorganism.

Progress and Milestones

A seven-year plan for technical evaluation, process development, and piloting of fermentation-derived acetic acid production technology has been developed, with the target of commissioning the first plant in 2010.The four major project tasks are summarized below:

- Economic and energetic valuation of acetic acid production
- Bioconversion of C1 feedstocks and acetate
- Separation and purification
- Integration of the production and purification

Commercialization

BP Amoco Chemicals will be responsible for commercializing the successful process. The company's expertise on the economics of acetic acid production will keep the project focused on technologies that are amendable to commercialization. Two areas of intellectual property that are required for successful demonstration of the project are already owned or will be developed by the technology partners in the project team. The target commercial introduction for the process is 2010.

Project Partners

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March 2003